

CLAIMS

1. A high-energy optical source capable of producing any desired waveform, comprising:

a source of input laser pulses;

a first dispersive element, for decomposing the input laser pulses into multiple frequency components directed along multiple optical paths;

multiple phase and amplitude modulators connected in the respective optical paths;

multiple power amplifiers connected in the respective optical paths;

a second dispersive element coupled to receive amplified optical signals from multiple power amplifiers and arranged to disperse light from the multiple optical paths along a single output optical axis, as a single amplified composite output beam; and

means for controlling the multiple phase and amplitude modulators to produce desired properties in the amplified composite output beam.

2. A high-energy optical source as defined in claim 1, wherein the source of input laser pulses comprises a mode-locked master oscillator.

3. A high-energy optical source as defined in claim 1, wherein the first and second dispersive elements comprise optical gratings.

4. A high-energy optical source as defined in claim 1, wherein the means for controlling the multiple phase and amplitude modulators comprises:

a first beam sampler, for obtaining a first sample from the input laser pulses;

a second beam sampler, for obtaining a second sample from the amplified composite output beam;

means for frequency shifting one of the first and second samples;

a third dispersal element, for decomposing the first and second samples into multiple frequency components;

a sensor array coupled to receive both of the frequency-decomposed sample beams and to generate as a result electrical output signals indicative of relative phases of the frequency-decomposed sample beams; and

control electronics for processing the output signals from the sensor array and generating a set of control signals coupled to the phase and amplitude modulators.

5. A high-energy optical source as defined in claim 4, wherein the control electronics are switchable to generate phase control signals of first and second types, wherein the control signals of the first type are effective to maintain the same phase relationships among the output signal components as exist among the input signal components, to produce an amplified output signal of the same waveform shape as the input signal, and the phase control signals of the second type are effective to disturb the phase relationships that exist among the input signal components and produce an output signal that is relatively low in amplitude.

6. A high-energy optical source as defined in claim 5, and further comprising a nonlinear optical converter coupled to receive the output signal, wherein the converter effectively suppresses the output signal when the phase control signals are of the second type.

7. A high-energy optical device, controllable to operate alternately in an “on” mode that generates a train of high-energy pulses and an “off” mode in which the high-energy pulses are suppressed, the optical device comprising:

a mode-locked laser for generating a continuous train of optical pulses in an input beam;

a first dispersive element, for decomposing the input beam into multiple frequency components coupled along multiple optical paths;

multiple phase modulators connected in the respective optical paths;

multiple power amplifiers connected in the respective optical paths;

a second dispersive element coupled to receive amplified optical signals from the multiple power amplifiers and arranged to disperse light from the multiple optical paths along a single output optical axis, as an amplified composite output beam; and

means for controlling the multiple phase modulators to switch between an “on” mode in which the mode-locked laser train of pulses is amplified and reproduced in the output beam, and an “off” mode in which the mode-locked train of pulses is effectively suppressed by appropriately disturbing in the output beam the relative phase relationships that existed among the frequency components of the input beam.

8. A high-energy optical device as defined in claim 7, and further comprising a nonlinear optical converter coupled to receive the output beam and to suppress by thresholding any signals output during the “off” mode of operation.

9. A method for generating a high-energy optical beam of any desired waveform, the method comprising:

generating an input beam comprising a train of pulses;

decomposing the input beam into multiple frequency components directed along multiple optical paths;

modulating the phase and amplitude of the multiple frequency components of the input beam;

amplifying the multiple frequency components in respective multiple power amplifiers connected in the respective optical paths;

recombining the multiple frequency components in a dispersive element arranged to disperse light from the multiple optical paths along a single output optical axis, as a single amplified composite output beam; and

controlling the modulating step to produce desired properties in the amplified composite output beam.

10. A method as defined in claim 9, wherein the step of controlling the multiple phase and amplitude modulators comprises:

using a first beam sampler to obtaining a first sample from the input laser pulses;

using a second beam sampler to obtain a second sample from the amplified composite output beam;

frequency shifting one of the first and second samples;

decomposing the first and second samples into multiple frequency components;

focusing both of the frequency-decomposed sample beams on sensor array;

generating in the sensor array electrical output signals indicative of relative phases of the frequency-decomposed sample beams; and

processing the output signals from the sensor array in control electronics, and generating a set of control signals to control the modulating step.

11. A method as defined in claim 4, and further comprising:

switching the control electronics to generate phase control signals of first type and second types, wherein the control signals of the first type are effective to maintain the same phase relationships among the output signal components as exist among the input signal components, to produce an amplified output signal of the same waveform shape as the input signal, and the phase control signals of the second type are effective to disturb the phase relationships that exist among the input signal components and produce an output signal that is relatively low in amplitude.

12. A method as defined in claim 11, and further comprising applying the output signal to a nonlinear optical converter, wherein the converter effectively suppresses the output signal when the phase control signals are of the second type.